

CHARGING CONNECTOR OVERHEAT DETECTION AND PROTECTION APPARATUS

TECHNICAL FIELD

[0001] This application is directed, in general, to an apparatus for a charging connector and, more specifically, to an apparatus for overheat detection and failure protection of a charging connector.

BACKGROUND

[0002] Mobile devices are required to perform more and more functions. As a result, the mobile devices have higher capacity batteries in order to have reasonable operating time. In order to charge the higher capacity batteries, larger charging currents are needed to keep the charging time reasonable. The popular charging interface for charging mobile devices is the Universal Serial Bus (USB) interface. More specifically, a micro USB interface in the mobile device. However, higher charging currents through a micro USB interface can have power dissipation problems due to the smaller interface and wear of cables and connectors.

SUMMARY OF SOME EMBODIMENTS OF THE INVENTION

[0003] One aspect of the present invention provides an apparatus that includes a resistive control block, coupled to a first data line and a second data line of a universal serial bus connector charging port. The resistive control block is configured to change a level of resistance between the first data line and the second data line. The apparatus further includes a sensing and adjustment block coupled to the universal serial bus connector charging port. The sensing and adjustment block is configured to sense a predetermined level of overheating of the universal serial bus connector charging port and cause the resistive control block to increase said level of resistance resulting in the universal serial bus connector charging port to appear as a different type of port.

[0004] Another aspect of the present invention provides an apparatus a resistive control block coupled to a ground line and an identification line of a universal serial bus connector of a portable device. The identification line is coupled to a universal serial bus controller of the portable device. The resistive control block is configured to change a level of resistance between the identification line and the ground line. The apparatus further includes a sensing and adjustment block coupled to the universal serial bus connector of the portable device and is configured to sense a predetermined level of overheating of the universal serial bus connector of the portable device. The sensing and adjustment block is further configured to cause the resistive control block to decrease the level of resistance between the identification line and the ground line to a predetermined level.

BRIEF DESCRIPTION OF THE FIGURES

[0005] Reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

[0006] FIG. 1 is a block diagram of an example charging environment for mobile devices;

[0007] FIG. 2 is a block diagram of charging problems of the charging environment of FIG. 1;

[0008] FIG. 3 is a block diagram of an example environment in which one embodiment of the invention may be implemented according to the principles of the present invention;

[0009] FIG. 4 is a block diagram of one embodiment of the invention of FIG. 3 in greater detail;

[0010] FIG. 5A is a block diagram of an embodiment of an apparatus within a charging device of FIG. 3;

[0011] FIG. 5B is a schematic illustration of an embodiment of a tangible storage medium 410 according to the invention;

[0012] FIG. 5C is a block diagram on an embodiment of an apparatus with a mobile device of FIG. 3;

[0013] FIG. 5D is a schematic illustration of an embodiment of a tangible storage medium 430 according to the invention;

[0014] FIG. 6A is a schematic illustration of an embodiment of the present invention;

[0015] FIG. 6B is a schematic illustration of another embodiment of the present invention;

[0016] FIG. 7 is a schematic illustration of an embodiment of the present invention;

[0017] FIG. 8A is block diagram of one placement of a sensor of FIG. 6A within the charging device of FIG. 3 according to one embodiment of the present invention;

[0018] FIG. 8B is a block diagram of one placement of a sensor of FIG. 6A within a charging device of FIG. 3 with a captive cable according to one embodiment of the present invention;

[0019] FIG. 9 is a flow diagram of one embodiment of a method according to the principles of the present invention; and

[0020] FIG. 10 is a flow diagram of another embodiment of a method according to the principles of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0021] Referring initially to FIG. 1, illustrated is a block diagram of an example charging environment for mobile devices. The environment includes a charging device 10 that is capable of providing a charging current via a Universal Serial Bus ("USB") connector 13. The charging device 10 may have a power plug 11 to obtain power from a conventional power receptacle and use conventional components (not shown) to convert Alternating Current (AC) to Direct Current (DC) at a predetermined voltage that are suitable for charging a mobile device 30 via a conventional USB cable 20. In another embodiment, the power plug 11 may be a conventional DC power plug (not shown) that connects to conventional components (not shown) that converts incoming DC current and voltage to the appropriate DC current and voltage for charging the mobile device 30. The charging device 10, in one embodiment, may include a battery 12 that is used to provide a charging current in case there is no AC power available or the charging device 10 does not comprise a power plug. Examples of a charging device 10 include USB charger, desktop computers, and laptop computers.

[0022] The USB connector 13 of the charging device 10 is coupled to one end of the USB cable 20 via a compatible type USB connector 21. The other end of the USB cable 20 is coupled to a USB connector 31 of the mobile device 30 via a compatible type USB connector 22. When the USB cable 20 is coupled to the charging device 10 and mobile device 30, the USB connector 13 of the charging device 10 would appear as